Oxford Cryosystems

OXFORD CRYOSYSTEMS

Coolstar 12W Coldheads – Models 0/12 and 2/9

# Operation & Instruction Guide

COOLSTAR COLDHEADS

# Operation & Instruction Guide v 1.4

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# 1 Introduction

## 1.1 Scope of this manual

This manual provides installation, operation and maintenance instructions for the following Oxford Cryosystems Ltd products:

**12W coldhead:**

• Coldhead Model 0/12 Part No. 22GM-910B550A

• Coldhead Model 2/9 Part No. 22GM-910B050A

## 1.2 General description

### 1.2.1 The Coolstar system

The Coolstar coldhead is used as part of a cryogenic cooling system, the components of which are shown in Figure 1.1. The system comprises of a Coolstar coldhead, a Cryodrive compressor and interconnecting helium gas lines. The compressor and gas lines are not automatically supplied with the coldhead and are covered in a separate set of working instructions.

The coldhead and compressor are connected by high and low pressure gas lines. High pressure helium gas provided by the compressor is cyclically expanded by the coldhead to low pressure and returned to the Compressor for recompression.

The Cryodrive compressor also provides power for the coldhead motor via an interconnecting motor cable. Coolstar coldheads are available in single and two stage versions and the model numbers for the coldheads are derived from the coldhead's nominal cooling power.

| **Type number** | **Type** | **Refrigerator power** |
|---|---|---|
| 0/12 | Single stage | 12 watts at 77 K |
| 2/9 | Two stage | 2 watts at 20K + 9 watts at 77 K |

**Table 1.1 - Coldhead types**

Single stage coldheads (one cooling surface) are capable of refrigerating to less than 25 K and two stage coldheads are capable of refrigerating to less than 10 K.

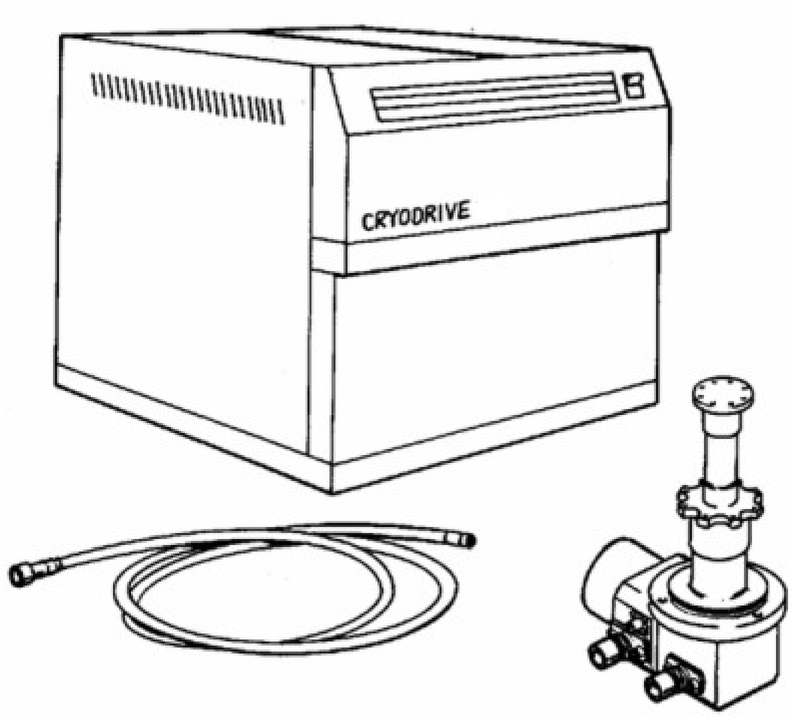



**Figure 1.1 - System components**

### 1.2.2 Coldhead features

Figure 1.2 and Figure 1.3 illustrate single and two stage coldheads, respectively, and identify significant features.

Copper heat stations provide a conductive surface to mount (with screws) components to be refrigerated.

The mounting flange has an ‘O` ring seal for installation in a vacuum enclosure and holes by which to secure the coldhead with appropriate length M6 cap head screws.

The motor cable and helium gas lines from the compressor are connected to the coldhead where shown. Line ends and coldhead connections are colour coded to facilitate correct hose orientation.

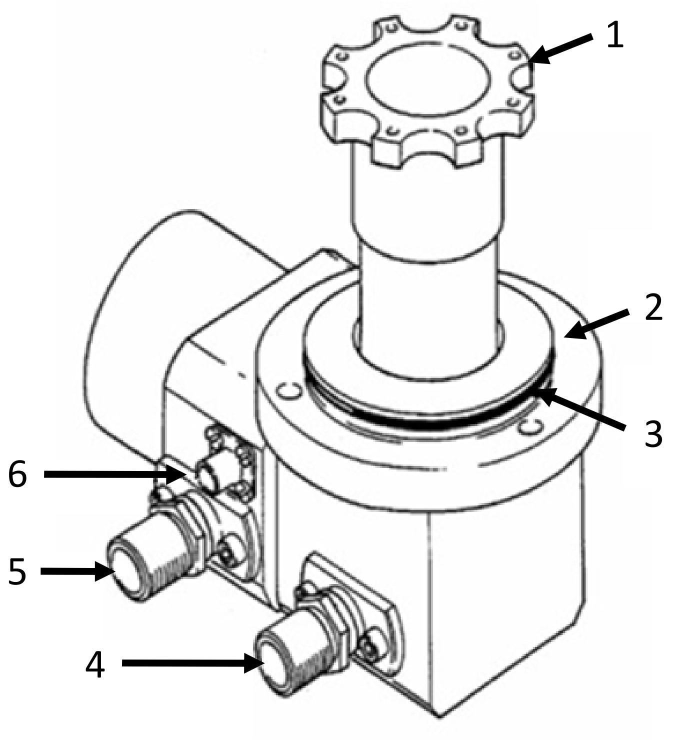



**Figure 1.2 - Single stage coldhead**

1. Heat station
2. Mounting flange
3. Vacuum enclosure 'O' ring
4. Low pressure line connection
5. High pressure line connection
6. Motor cable connection

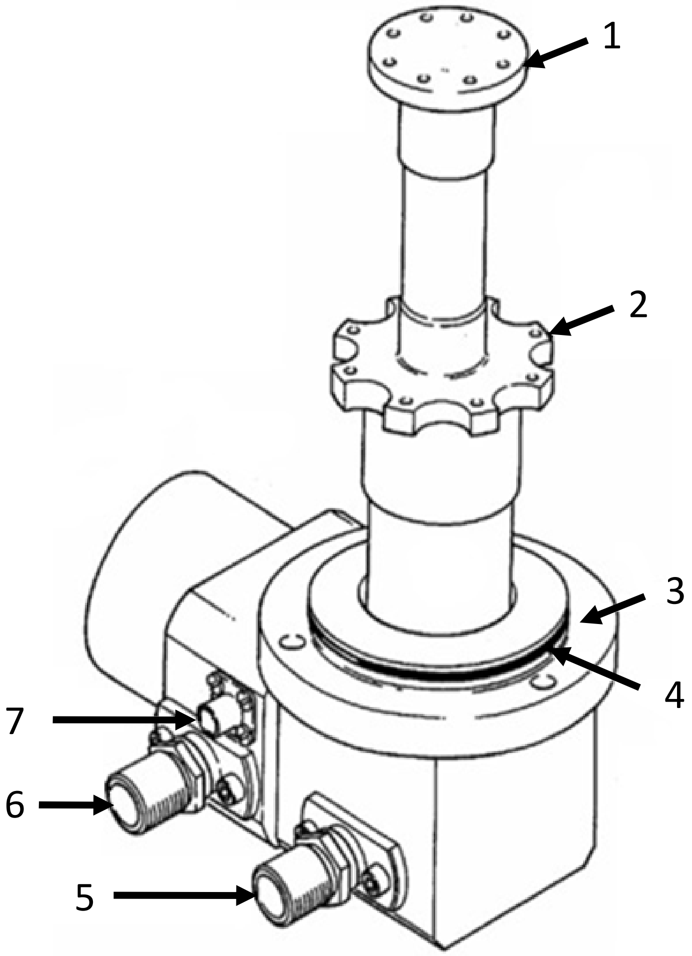



**Figure 1.3 - Two stage coldhead**

1. Second stage heat station
2. First stage heat station
3. Mounting flange
4. Vacuum enclosure 'O' Ring
5. Low pressure line connection
6. High pressure line connection
7. Motor cable connection

### 1.2.3 Construction

Figure 1.4 shows the components of one and two stage coldheads. Gas admission and discharge for the coldhead are controlled by a rotating valve driven by a stepper motor. The motor, valve, high pressure gas and motor cable connections are all parts of the motor housing assembly.

The drive housing contains the valve plate, piston seal, low pressure gas connector and over-pressure relief valve.

Displacers have dynamic seals and integral thermal regenerators constructed of phosphor bronze mesh (first stage) and lead spheres (second stage). Buffers decelerate the displacers at stroke ends. The displacers operate within the tube assembly which comprises a mounting flange and tube extending to the first stage and second stage heat stations.

The piston, attached to the displacers, operates within a separate chamber sealed from the tube assembly volume by the piston seal.

Ports in the valve plate and drive housing communicate high and low pressure gas between the rotary valve and the working volumes. “Drive” gas communicates with the piston chamber and "Process" gas with the displacers.

Moving parts have been kept to a minimum and the components subject to wear are principally the PTFE based dynamic seals. These include the following:

- Valve
- Warm seal
- Cold seal
- Piston seal

Instructions for replacing these items are given in Section 7. In addition, service manuals for the coldheads are available to download from the Oxford Cryosystems website at www.oxcryo.com/coolstar/manuals.htm.

#### 1.2.4 Operational description

Coolstar coldheads operate to the Gifford-McMahon cycle developed from the Taconis cycle by Professor Gifford and his associate McMahon in the late 1950’s.

High pressure helium gas provided by the Cryodrive compressor is cyclically expanded by the coldhead to low pressure and returned to the compressor for recompression.

High pressure gas admission and low pressure discharge are controlled at the coldhead by the rotary valve. The valve face profile and valve ports position in the valve plate provide cycle timing.

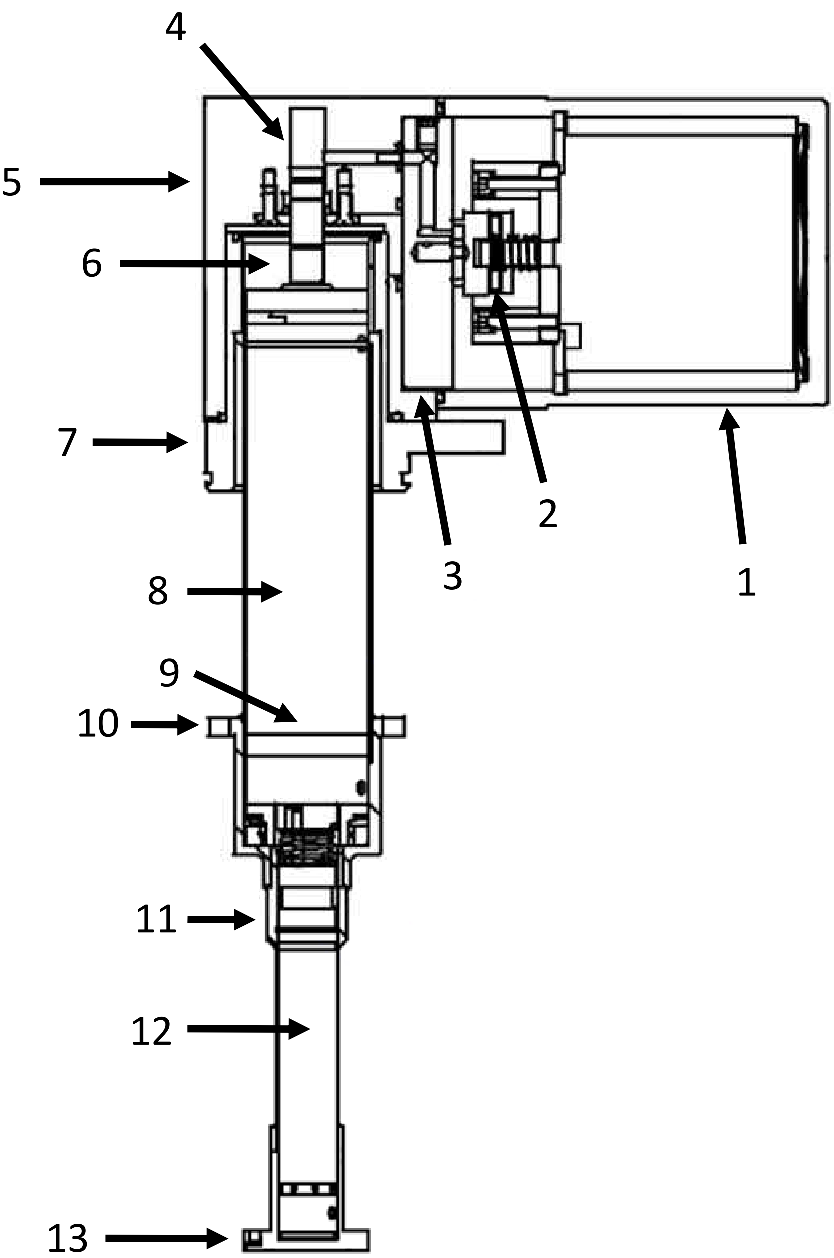



**Figure 1.4 - 2/9 coldhead assembly**

1. Motor housing
2. Valve
3. Valve plate
4. Piston and piston seal
5. Drive housing
6. Warm buffer and warm seal
7. Tube assembly
8. First stage displacer
9. Cold buffer
10. First stage heat station
11. Cold seal
12. Second stage displacer
13. Second stage heat station

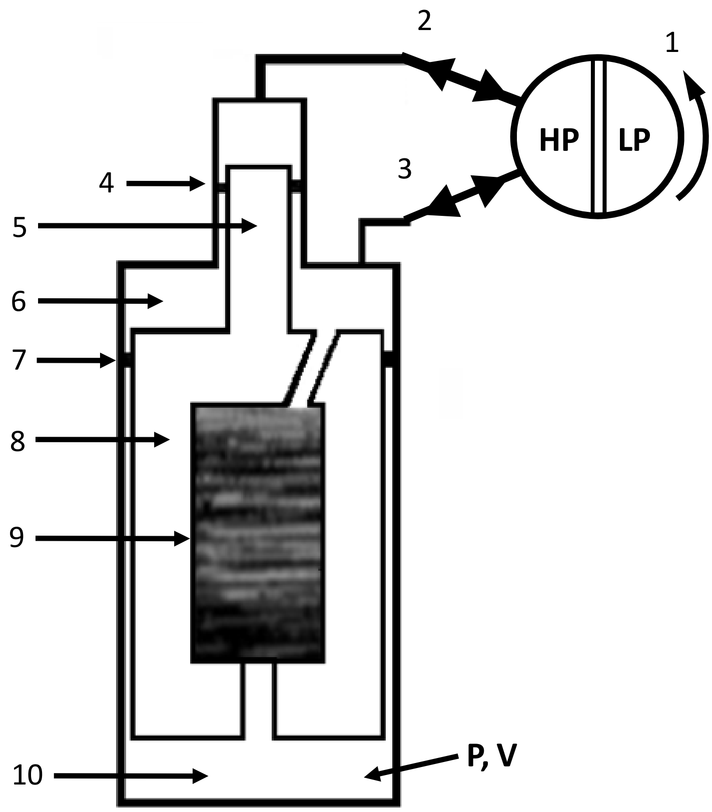



**Figure 1.5 - Coldhead operational steps**

| | | | |
|---|---|---|---|
| 1. | Rotary valve | 7. | Displacer seal |
| 2. | Drive gas | 8. | Displacer |
| 3. | Process gas | 9. | Regenerator |
| 4. | Piston seal | 10. | Cold volumes |
| 5. | Piston | LP | Gas at 10 bar |
| 6. | Warm volume | HP | Gas at 22 bar |

The Coolstar coldhead operates between 22 bar high pressure (HP) and 10 bar low pressure (LP).

Cycle frequency is twice the valve rotational speed. At high temperature, coldhead power is approximately proportional to cycle frequency. At low temperatures the high speed cycle efficiency is degenerated by internal gas pressure difference and possible limitation of compressor gas flow. Motor speeds above 72 rpm may not benefit low temperature performance.

The four principal steps to the cycle are illustrated in Figure 1.6 which shows a schematic of a single stage coldhead.

The regenerator acts as a thermal sponge, either taking in heat (step 2) and cooling the gas, or imparting heat (step 4) and warming the gas. Since refrigeration produced in each cycle is conserved, the coldhead will cool down until the parasitic losses and applied heat load equate with the refrigeration developed by gas expansion.

**STEP 1**

Drive pressure at 22 bar (HP) holds the displacer at stroke end. Process gas pressurises the displacer to 22 bar (HP).

**STEP 2**

Drive pressure has reduced to 10 bar (LP). The displacer is moving to increase the cold volume, driven by pressure difference across the piston. Gas entering the cold volume is cooled by the regenerator.

**STEP 3**

The displacer has reached stroke end. Process gas depressurises to 10 bar (LP) expanding and cooling the cold volume gas entropically.

**STEP 4**

The drive pressure has increased to 22 bar (HP). The displacer moves to reduce the cold volume by pressure difference across the piston. Gas leaving the cold volume cools the regenerator.

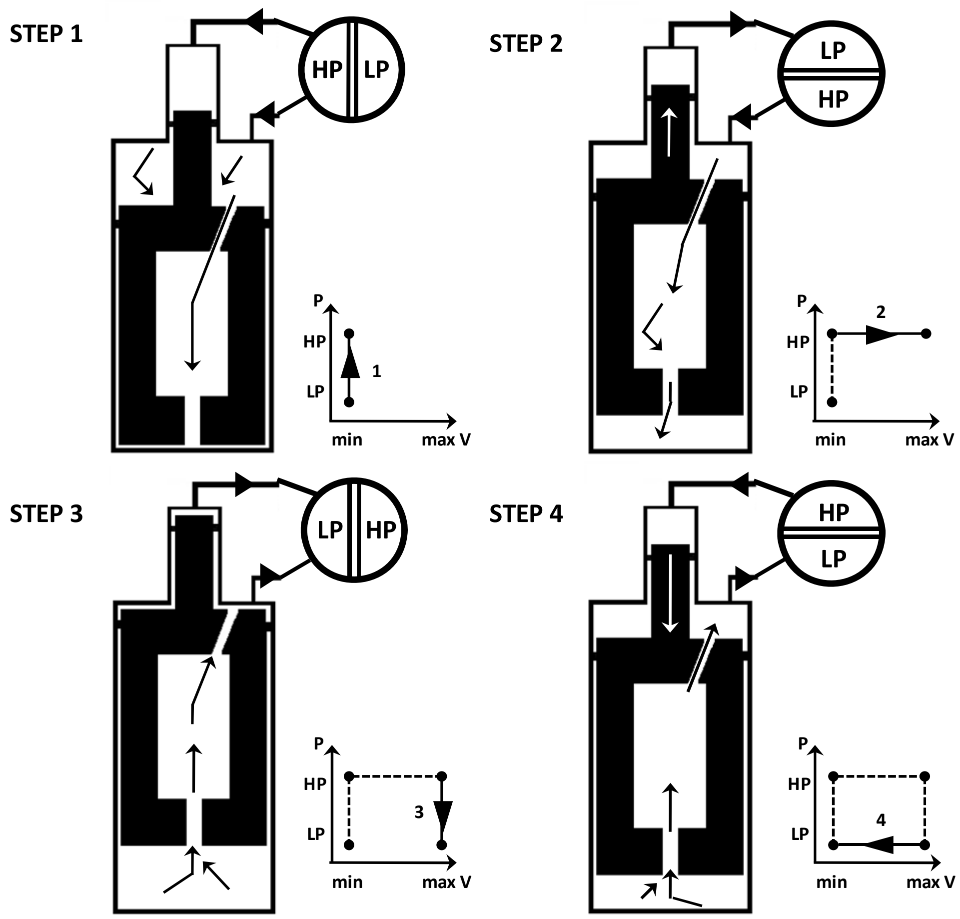



**Figure 1.6 - Coldhead operational steps (continued)**

## 1.3 Controlling refrigeration power

The Coolstar coldheads are fitted with a variable speed stepper motor to drive the rotary valve. The motor speed is adjustable between 25 and 100 rpm (50 and 200 cpm) and can be used to control coldhead refrigeration. Normal speeds of 60 and 72 rpm (50 and 60 Hz supply frequencies, respectively) are the maximum recommended continuous running speeds to maintain 15000 hr service interval. Higher speeds will not provide increased refrigeration below approximately 16 K and 25 K for 2 stage and single stage models, respectively.

There are two options available for speed control; Preset and Variable.

### 1.3.1 Preset speed control

The Cryodrive compressor microprocessor controller contains various cool down time, cool down "boost" speed and normal speed programmes stored on palettes.

Boost speed increases coldhead motor speed for a programmed time to 90 rpm. This has the advantage of increasing refrigerating power (to approximately 16 K and 25 K for 2 stage and single stage heads, respectively) and therefore provides a fast cool down. The most appropriate cool down time will depend largely upon the heat to be extracted from the refrigerated mass.

After the cool down boost period, normal speed is automatically re-established. Palette options and selection details are provided in the Cryodrive Installation and Operation Manual. For a copy of this manual please contact Oxford Cryosystems.

### 1.3.2 Variable speed control

It is possible to drive the coldhead valve motor at any speed between 25 rpm and 100 rpm in analogue speed control. To set the system speed control accordingly, please refer to Section 5 in the Cryodrive Installation and Operation Manual. With the Cryodrive compressor configured for analogue speed control, all automatic speed control normally provided by the microprocessor controller, (e.g. cool down boosts) are disabled. Coldhead speed can be 'boosted' to increase cooling power to cope with high refrigeration loads or slow speeds can be adopted during periods when the coldhead cooling power requirement is at a minimum.

In analogue speed control mode there is no time limit on how long the selected speed can be maintained. It should be noted that the coldhead seal wear rate depends on the cycle frequency and that increasing speeds will increase the frequency of seal replacement. For this reason, coldhead speeds in excess of 72 rpm should preferably be maintained for a limited period.

## 1.4 Remote control

By providing voltage signals to the Parallel Command and Status Port (PCSP), located at the rear of the Cryodrive microprocessor controller, (logic 0V on, 24V off) control of the coldhead speed for cool down, boost, normal and standby can be achieved individually for each of the two coldhead control channels contained within the Cryodrive microprocessor controller. By providing the appropriate logic input signal to these pins on the PCSP, cool down, normal, standby and boost speeds are selected from the data stored on the configured 'palette' and initiated for that channel. Cool down and normal speeds are used in the same manner as outlined in the previous section. Standby speed can only be selected by using the PCSP interface and is used predominantly when coldhead power is not in demand. Boost speed is selected in the same manner using the PCSP interface and can be used for periods when the application demands a higher coldhead cooling power. Again when standby or boost is selected using the PCSP interface the coldhead motor speed selected is that contained in the Cryodrive configured palette. The period allowed for boost operation is limited to a time value aim stored on the configured palette (after which normal speeds are resumed) thus

preventing long period of boost operation causing premature seal wear. If longer boost periods are required, boost must be re-initiated when the stored boost time has timed out. See Section 5 of the Cryodrive Installation and Operational Manual for further details of PCSP control features.

# 2 Specification and data

## 2.1 General data

**Note**

Two stage coldhead cooling powers at 20 K and 77 K measured simultaneously.

All performances are measured with the coldhead vacuum insulated to less than 10-3 mbar and wrapped with 5 layers of aluminised mylar.

| **Coldhead Model**<br>Number of Stages | **0/12**<br>1 | **2/9**<br>2 |
|---|---|---|
| ***Cooling Power at 20 K in Watts*** | | |
| Normal Speed (50 Hz) 60 rpm | - | 1.8 |
| Normal Speed (60 Hz) 72 rpm | - | 2.1 |
| Boost Speed 90 rpm | - | 2.4 |
| Standby Speed 45 rpm | - | 1.1 |
| ***Cooling Power at 77 K in Watts*** | | |
| Normal Speed (50 Hz) 60 rpm | 12.0 | 9.1 |
| Normal Speed (60 Hz) 72 rpm | 14.5 | 10.6 |
| Boost Speed 90 rpm | 17.0 | 11.0 |
| Standby Speed 45 rpm | 8.0 | 6.2 |
| ***Cooldown Time Minutes*** | | |
| To 20 K | - | <16 |
| To 77 K | <11 | - |
| Increase in cool down time for each 100 g copper addition | 6 | 14 |
| **Base Temperature (K)** | | |
| Normal Speed | 26 | 9.0 |
| Boost Speed | 25 | 8.5 |
| Coldhead Weight (kg) | 2.4 | 2.5 |
| Coldhead Service Interval (hours) | 15,000 recommended | |

**Table 2.1 - General data**

## 2.2 Dimensions

The dimensional details of each coldhead are given in Figure 2.1 and Figure 2.2.

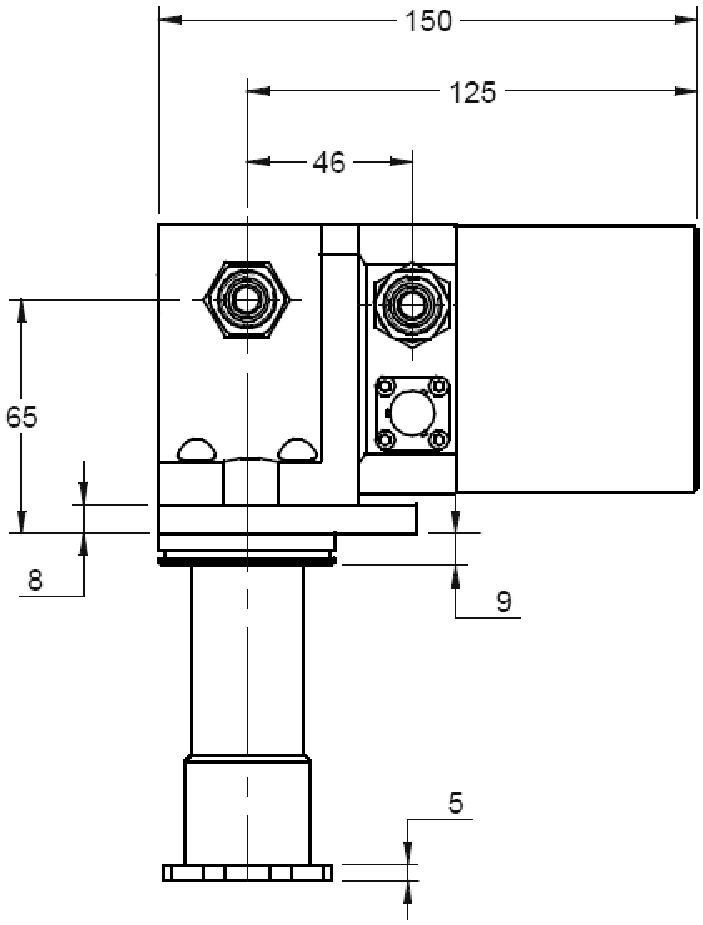



**Figure 2.1 - Coldhead model 0/12 dimensional details**

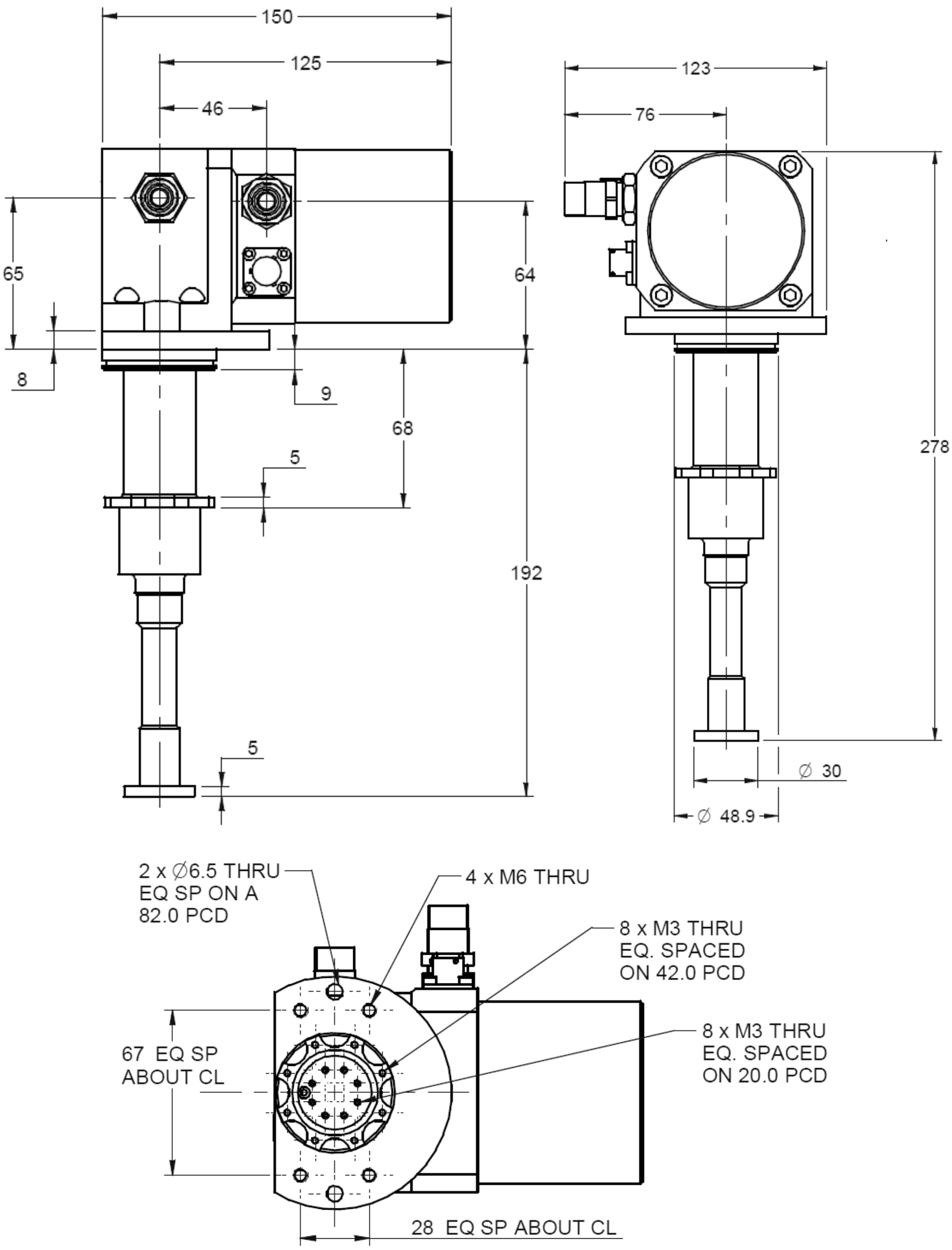



**Figure 2.2 - Coldhead model 2/9 dimension details**

## 2.3 Performance data

The diagrams shown in Figure 2.3 to Figure 2.7 give detailed information on the performance of each model of coldhead.

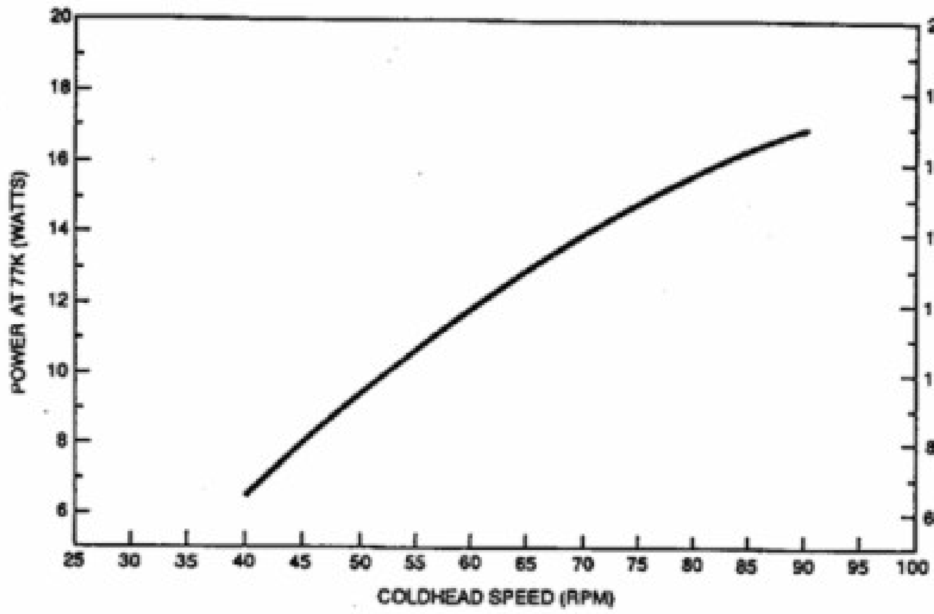



**Figure 2.3 - Model 0/12 power vs speed graph (Cryodrive 1.5 kW/50 Hz)**

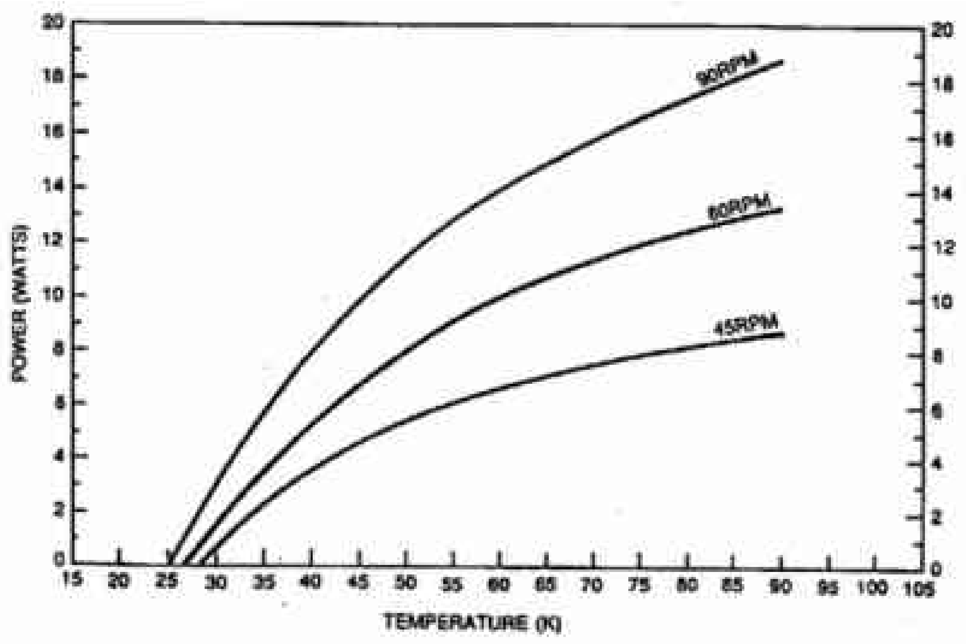



**Figure 2.4 - Model 0/12 power vs temperature graph (Cryodrive 1.5 kW/50 Hz)**

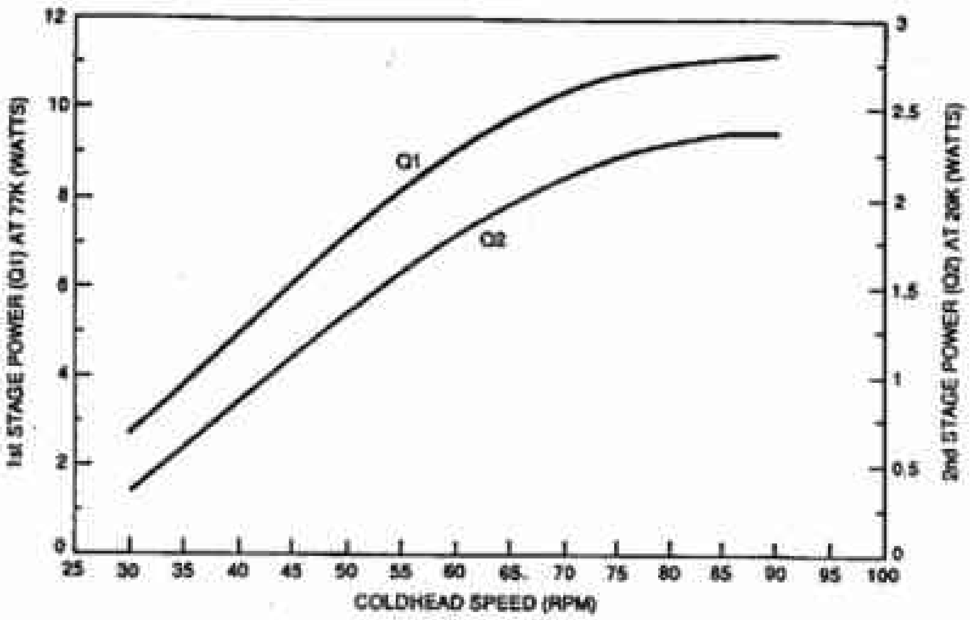



**Figure 2.5 - Model 2/9 power vs speed (Cryodrive 1.5 kW/50 Hz)**

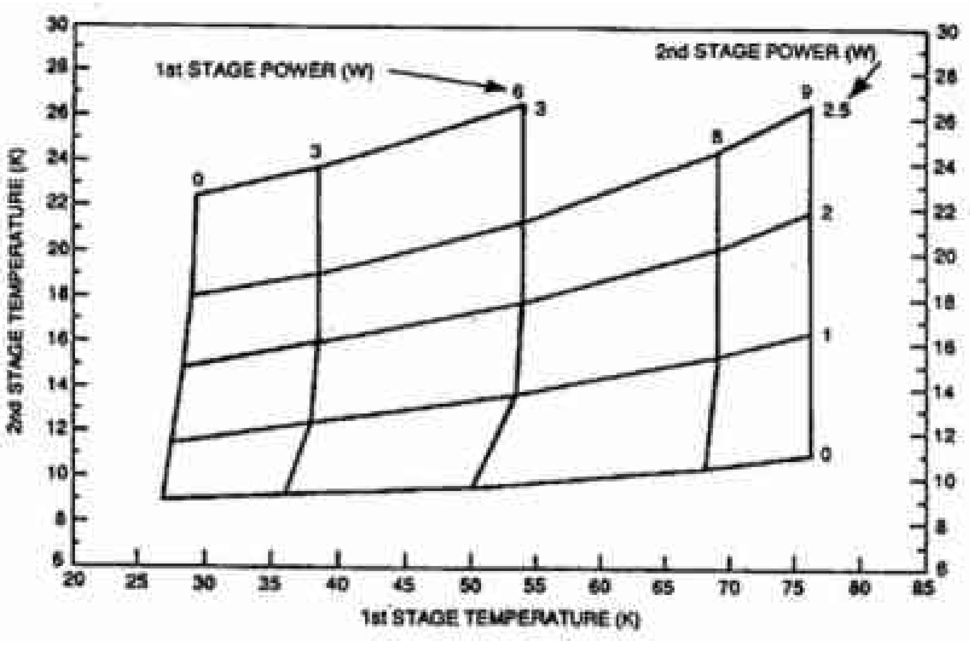



**Figure 2.6 - Model 2/9 60 rpm power net diagram (Cryodrive 1.5 kW/50 Hz)**

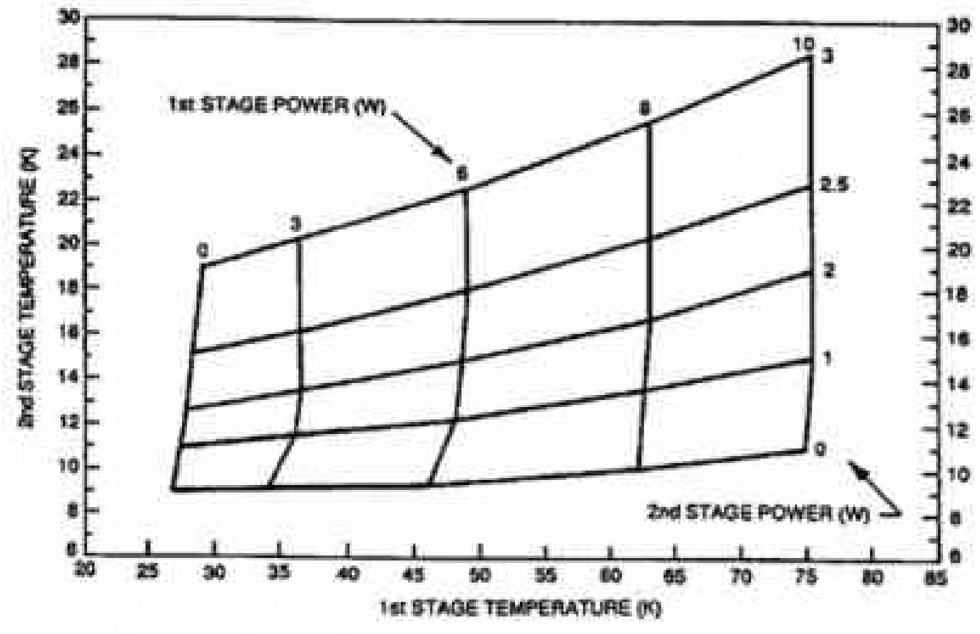



**Figure 2.7 - Model 2/9 72 rpm power net diagram (Cryodrive 1.5 kW/60 Hz)**

# 3 Installation

## 3.1 Unpacking and inspection

The Coolstar coldhead should be unpacked and inspected for evidence of damage immediately on receipt from Oxford Cryosystems. Check that the following components have been supplied:

| Qty | Item |
|---|---|
| 1 | Coldhead |
| 1 | Instruction manual |
| 1 | Coldhead motor cable |

Inspect all connectors and sealing flanges for signs of damage; ensure that protective covers are replaced after inspection.

If evidence of damage or shortage is found, notify Oxford Cryosystems and the carriers immediately. If the equipment is not to be installed immediately, repack and store in clean, dry conditions until required. The coldhead motor cable is unique to the coldhead; please retain the cable with its associated coldhead.

## 3.2 Design considerations

This section outlines a number of general design considerations which affect the performance of the coldheads. They are provided as a guide to enable the purchaser to obtain the best performance from the coldhead.

### 3.2.1 Mounting

The coldhead can be mounted in any orientation. Details of the dimensions and fixing hole locations are given in Figure 2.1 and Figure 2.2. Consideration must be given when designing the flange to ensure that the orientation of the gas lines will not foul any other equipment mounted on the flange.

### 3.2.2 Load connection

Normally assemblies to be refrigerated are mounted directly on to the coldhead heat stations using a gasket of indium to promote good heat transfer across imperfect surfaces.

WARNING

Indium metal is toxic. Ensure adequate precautions are taken to avoid skin contact or ingestion. Ensure safe disposal of any unused material.

Due to low material specific heat at low temperature there is a slight cycling of heat station temperature over the coldhead cycle period. If necessary this can be attenuated by providing an inferior conductor between heat station and load such as a stainless steel wafer or copper braid. Such measures result in some loss of refrigeration measured at the conductor end.

In two stage machines, it is common practice to heat sink connections from ambient at the first stage to reduce second stage conducted heat load.

Where practical, conductors to low temperature surfaces should be made of small sections and be long and indirect to reduce conducted heat load.

Approximate values of Thermal Conductivity:

| Material | CONDUCTION-WATTS/CM | |
|---|---|---|
| | 300 K to 70 K | 70 K to 15 K |
| Copper | 930 | 620 |
| Aluminium | 510 | 200 |
| Stainless steel | 27 | 3 |
| PTFE/Perspex/Nylon | <0.7 | <0.11 |

**Table 3.1 - Thermal conductivity of materials**

#### 3.2.3 Vacuum insulation

It is necessary to evacuate the vacuum enclosure to better than 10-2 mbar at room temperature. This is most conveniently achieved with a rotary pump preferably fitted with a molecular sieve trap to prevent migration of pump oil to the vacuum enclosure. The vacuum pump system should be valved out before coldhead operation to avoid cryopumping the pump and/or trap.

There should be a dramatic improvement in vacuum enclosure pressure at approximately 35 K as the refrigerated surfaces cryopump residual air.

The coldhead performance will be degraded by gas conduction if the enclosure pressure is not better than 10~3 mbar at low temperature.

#### 3.2.4 Radiation shielding

Lowest temperatures are achieved if shielding is used to reduce radiant heat loads. This may take the form of rigid reflective shielding of the second stage mounted on the first stage (in the case of a two stage machine) or several layers of aluminised mylar.

#### 3.2.5 Non-vacuum insulation

This generally applies only to single stage machines because the ultimate temperature achievable will be limited by air condensation.

Consideration should be given to ice and $CO_2$ forming on refrigerated surfaces and the problems created when the coldhead is warmed and thawing ice layers produce loose water.

Closed cell (non porous) plastic materials enclosing refrigerated surfaces provide some insulation and limit ice accumulation.

#### 3.2.6 Liquification

Single stage coldheads can be used to produce small quantities of liquid air but the user should be made aware of the hazards of oxygen enrichment.

> WARNING
>
> Oxygen enrichment by preferential boiling of nitrogen from liquid air can produce explosive burning and must be avoided.

It is preferable to produce only liquid nitrogen by shrouding the refrigerated surface with nitrogen gas and excluding all air.

## 3.3 Installation procedure

### 3.3.1 Positioning the coldhead

1. If an inlet 'O' ring seal is fitted to the flange, check that the seal is correctly fitted and lightly lubricated with vacuum grease.

2. Fit the coldhead to the vacuum chamber flange.

3. Secure the coldhead to the object to be cooled ensuring good thermal contact and using the correct fittings (see Section 3.2.1). Check that the coldhead is correctly orientated to enable the helium gas lines to be fitted.

4. Remove dust plugs and caps from the interconnecting helium gas lines and from the coldhead and compressor gas supply and return connections. Ensure that all the exposed sealing faces of these connections are free from debris that would affect the seal quality and are lightly lubricated with vacuum grease.

### 3.3.2 Interconnecting coldhead and compressor

Connect the helium gas lines between the compressor unit and coldhead, in the following order. Refer to Sections 3.3.3 and 3.3.4 and Figure 3.1 and Figure 3.2 for details of the self-sealing couplings used and the recommended procedures for connecting and disconnecting the couplings.

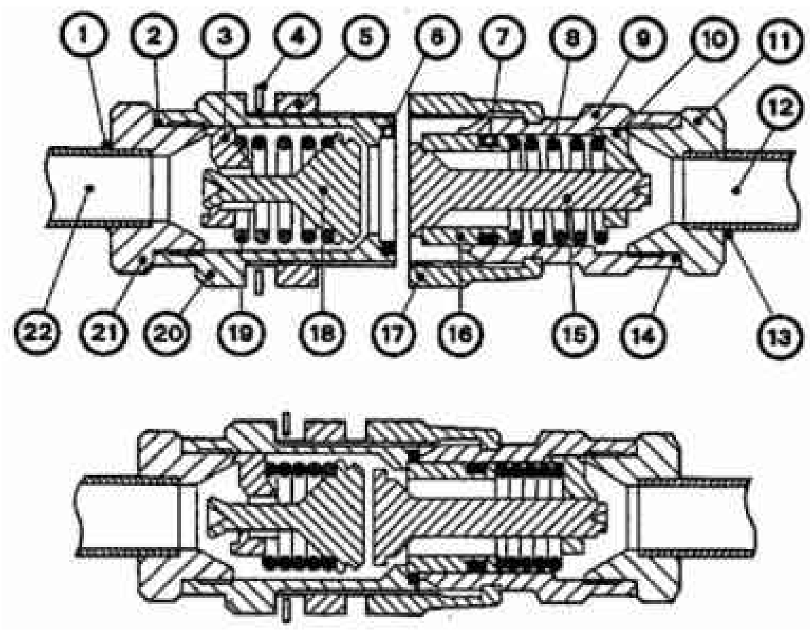



**Figure 3.1 - Quick release aeroquip coupling**

1. Brazed joints
2. 'O' Ring seal
3. Retainer
4. Lock washer
5. Lock nut
6. Rubber gasket
7. Packing ring
8. Spring
9. Body
10. Retainer
11. Adaptor
12. Tubing
13. Brazed Joints
14. 'O' Ring seal
15. Stem valves
16. Bonded sleeve
17. Union nut
18. Poppet valve
19. Spring
20. Body
21. Adaptor
22. Tubing

CAUTION

The gas line coupling halves may be damaged if the coupling halves are allowed to rotate during connection or disconnection.

*Note: All helium gas hose connections are colour coded.*

1. Connect the GREEN helium return line to the GREEN gas return connector at the rear of the compressor unit.

2. Connect the RED helium supply line to the RED gas supply connector at the rear of the compressor unit.

3. Connect the RED helium supply line to the RED gas supply connector at the coldhead.

4. Connect the GREEN helium return line to the GREEN gas return connector at the coldhead.

5. Check the pressure gauge reading on the compressor unit. The static pressure of a typical coldhead installation at an ambient temperature in the range 16˚C to 38˚C (61˚F to 100˚F) and using the 3 metre interconnecting gas lines should be 16.5 ± 1.0 bar (239 ± 145 p.s.i.g.).

6. If the indicated pressure is below 15.5 bar (225 p.s.i.g.) but higher than 2 bar (29 p.s.i.g.), add helium gas as detailed in the Cryodrive Installation and Operation Manual - Section 7.

CAUTION

If the compressor unit pressure gauge reads less than 2.0 bar pressure, contact Oxford Cryosystems.

7. Connect the coldhead motor cable to the bayonet fitting on the coldhead motor housing. Pass the lead through the port in the rear panel of the compressor unit and connect to the socket marked coldhead 1 on the rear of the compressor control module. Attach the cable screen earth to the adjacent earth stud at the rear of the control module.

8. The coldhead motor cable should be 'strain relieved', using the tie wraps provided, to the hole located in the plate provided at the point of entry through the compressor rear panel.

9. Set the Cryodrive compressor palette number for the most appropriate boost speed duration, or connect to the PCSP interface for variable/remote speed control (see Section 1.3 and the Cryodrive Installation and Operation Manual - Section 5).

10. The coldhead is now installed and is ready for operation once suitable vacuum conditions have been achieved.

#### 3.3.3 Method of disconnecting a self-sealing coupling

Note: Two spanners must be used for this operation to avoid damage to the coupling.

8. Take the two spanners and place them on the female half of the self-sealing coupling as shown in Figure 3.2.

9. Hold spanner 'B' stationary and turn spanner 'A' in the direction shown by the green arrow to unscrew the two halves of the coupling.

*Note: A small amount of gas may leak from the coupling whilst it is being disconnected; complete the procedure quickly to prevent excessive gas leakage.*

### 3.3.4 Method of connecting a self-sealing coupling

Note: Two spanners must be used for this operation to avoid damage to the coupling.

1. Check that the internal surfaces of the two halves of the coupling are dean and that the rubber gasket is in place - refer to Figure 3.1 for details of the coupling.

2. Connect the coupling halves by hand until resistance is felt.

3. Take the two spanners and place them on the female half of the self-sealing coupling as shown in Figure 3.2.

4. Hold spanner 'B' stationary and turn spanner 'A' in direction opposite shown by the green arrow to connect the two halves of the coupling. DO NOT OVERTIGHTEN.

*Note: A small amount of gas may leak from the coupling whilst it is being connected; complete the procedure quickly to prevent excessive gas leakage.*

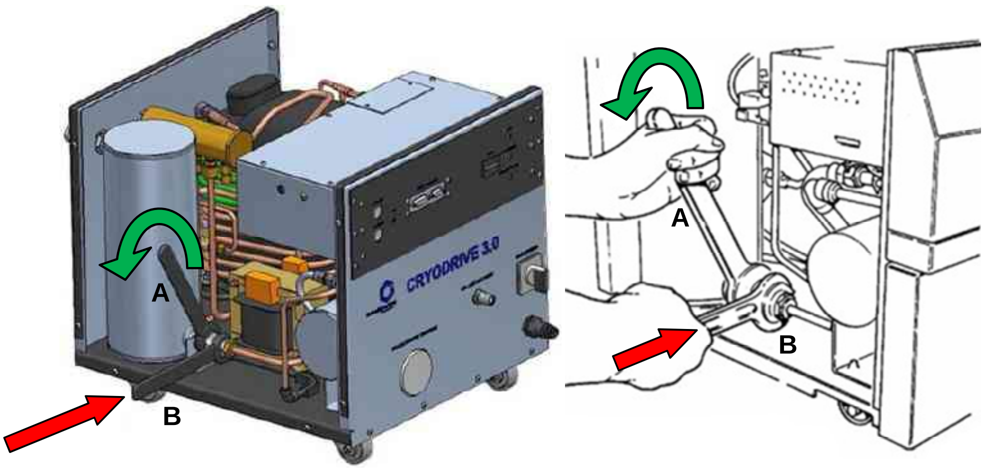



**Figure 3.2 - Connecting and disconnecting a self-sealing coupling: new type Cryodrive (left) and old type Cryodrive (right)**

| Aeroquip coupling size | Spanner | Spanner size |
|---|---|---|
| 1/4 Inch | A | 5/8 Inch AF |
| | B | ¾ Inch AF |
| 1/2 Inch | A | 1 3/16 Inch AF |
| | B | 1" Inch AF |

## 3.4 Multiple coldhead installations

When more than one coldhead is to be driven from a single Cryodrive compressor unit, sufficient helium gas must be provided by the compressor to match the requirements of the coldhead. As a simple guide an index system has been devised to simplify the selection of suitable coldhead/compressor combinations.

From the following table (where the combined index for the coldheads is equal to or less than that of the compressor unit) the performance of the coldheads within the combination will be to standard specification.

| Coldhead Model | Index No. | Cryodrive | Index No. |
|---|---|---|---|
| 0/12 | 2 | 1.5 | 8 |
| 2/9 | 5 | 3.0 | 14 |

If the combined coldhead index exceeds the compressor index by a value not exceeding 4, then the combination is possible but a reduction in coldhead performance will result. The performance loss would be acceptable for those applications that are not particularly demanding of coldhead cooling power. The performance change predominantly affects the maximum heat absorption rate of the coldhead whilst other parameters will be affected to a much lesser extent. If in doubt please contact Oxford Cryosystems to discuss your particular application.

### 3.4.1 Coldhead helium connections

For multiple coldhead installations it will be necessary to install helium 'T' pieces (for two heads) and 'X' pieces (for triple heads) to the helium supply and return connections at the rear of the Cryodrive compressor. These manifolds are installed between the coldhead gas lines and the compressor following the colour code sequence (GREEN to the compressor return connection, RED to the supply connection) with the single female connector of each manifold connected to the helium supply and return connections on the rear panel of the Cryodrive compressor. The correct procedure, as detailed in Section 3.3, should be followed when connecting the self-sealing couplings. The gas lines should be connected for each coldhead in the following sequence:

1. Connect the GREEN helium return line to one of the GREEN gas return connectors on the manifold.

2. Connect the RED helium supply line to the RED gas supply manifold using the equivalent position as used for the GREEN gas line.

3. Connect the RED helium supply line to the RED connector at the coldhead.

4. Connect the GREEN helium return line to the GREEN connector to the coldhead.

After completing all gas line connections, check the helium pressure gauge reading on the Compressor unit. The static pressure of a typical coldhead installation at an ambient temperature in the range 16°C to 38°C should be 16.5± 1.0 bar (239 ±145 p.s.i.g.),

## 3.5 Motor cable installation

In applications where more than two coldheads are to be powered from a single compressor a line splitter should be used. This allows the connection of two coldheads to each of the two output connections at the rear of the compressor Cryocontroller module.

To connect the coldhead motor cables:

1. In old type Cryodrive models, remove the compressor left hand cover to gain access to the compressor system control box.

2. Locate the socket marked "COLDHEAD 1" on the rear of the compressor control module (located at the front of the new type Cryodrive) and insert the appropriate coldhead motor cable connector. Attach the cable screen earth to the adjacent earth stud at the rear of the control module.

3. Pass the cable out through the cable aperture in the rear of the compressor unit.

4. Connect the free end of this cable to the coldhead hermetic connector located on the coldhead and ensure that the locking ring is fully rotated.

5. Repeat the procedure for the remaining coldheads using the second socket marked "COLDHEAD 2".

**CAUTION**

Never try to connect more than 2 Coolstar coldheads to one Cryodrive drive channel. Never operate a single coldhead through a 'line splitter' accessory. Failure to comply with these conditions may result in damage to the Cryodrive controller and the coldhead drive motor.

# 4 Operation

## 4.1 Start up

Before using the coldheads, carry out the following pre-start checks:

1. Check the Cryodrive compressor gas pressure.

2. Establish compressor cooling water flow.

3. Check that the vacuum enclosure pressure is better than 10-2 mbar and re-evacuate; if necessary, isolate the vacuum line.

4. Start the compressor by switching the COMPRESSOR ON/OFF switch to ON. The compressor will then start after a 3 second delay.

5. The coldhead should then commence operation producing a light tapping noise. If no motion can be detected, refer to Section 5 for fault finding.

## 4.2 Normal operation

The Coolstar coldhead is designed to operate unattended under normal operating conditions, with an occasional check of the compressor unit helium pressure gauge reading. The gauge should indicate a pressure in the range 19 to 22 mbar (290 to 319 p.s.i.g) depending on coldhead operating temperature. If the gauge reading varies above or below this range refer to the fault finding procedures detailed in Section 5.4 of the Cryodrive Installation and Operation Manual.

## 4.3 Shut-down

1. Switch the COMPRESSOR ON/OFF switch to OFF.

2. Isolate compressor cooling water flow.

3. Preferably, do not expose refrigerated surfaces to atmosphere immediately after shut down. Allow the coldhead to warm up to room temperature before exposure, this will minimise the quantity of atmospheric water vapour wetting.

# 5 Fault finding

| Symptom | Fault | Remedial Action |
| --- | --- | --- |
| Coldhead fails to operate. | Compressor not operating.<br><br>Motor cable not connected.<br><br>Gas lines not connected or not fully connected.<br><br>Gas lines mixed. | Check compressor.<br><br>Check motor cable connection at coldhead and compressor.<br><br>Check line connections at coldhead and compressor.<br><br>Check compressor adsorber Connection and check line coupling colour bands agree. |
| Coldhead runs only briefly. | Compressor tripped. | Check compressor over temperature trip/cooling water flow (takes several minutes to clear trip).<br><br>Check compressor under pressure trip/static pressure (see Section 3.3.2 Step 6). |
| Coldhead will not cool down. | Gas lines not fully connected. | Check line connections at coldhead and compressor.<br><br>Check compressor adsorber connection. |
| Coldhead will not cool down. | Poor enclosure vacuum.<br><br>Defective thermometers.<br><br>High conducted heat load. | Check enclosure vacuum.<br><br>Check thermometer accuracy.<br><br>Check load calculation.<br><br>Check installation for thermal short. |
| Coldhead will not cool to normal operating temperature. | Poor enclosure vacuum.<br><br>System helium gas contaminated (temperature tends to cycle).<br><br>Seals worn. | Check enclosure vacuum.<br><br>Decontaminate as detailed in Section 6.2.<br><br>Replace seals as detailed in Section 7. |

# 6 Maintenance procedure

WARNING

Before carrying out any work on the compressor or coldhead, ensure that the electrical supply to the installation has been disconnected and isolated by switching the supply circuit isolating switch to 'OFF'. If possible lock the switch in the 'OFF' position and withdraw the circuit fuses.

## 6.1 Adding helium gas

It should be necessary to add helium gas to the system only occasionally during normal operation to counteract small losses caused by coupling and de-coupling gas lines, etc. If it becomes necessary to add helium frequently i.e. every few months, the installation should be checked for minor leaks. Leaks are generally caused by incorrectly tightened self-sealing couplings, debris on the coupling sealing faces or badly seated relief valves.

Adding helium gas should be carried out in accordance with the Cryodrive Installation and Operating Manual, Section 5.3.

CAUTION

Do not use helium that is less than 99.995% pure (dew point -27°C/ -16.6°F).

## 6.2 Decontamination procedures

The use of helium gas of insufficient purity is the main cause of helium contamination in coldheads. Helium gas that is 99.995% pure with a dew point of -27°C (-16.6°F) should always be used. Helium gas generally available for industrial uses (e.g. helium leak detection and welding), is not usually sufficiently pure and must NOT be used in a Coolstar coldhead.

Contamination of the helium gas circuit of a Coolstar coldhead is usually indicated by sluggish or intermittent operation of the coldhead displacer resulting in poor ultimate temperatures. In severe cases of contamination the displacer will seize.

If a Coolstar coldhead becomes contaminated, the following decontamination procedure should be carried out to restore its performance. In cases of severe contamination Oxford Cryosystems should be contacted.

To decontaminate a Coolstar coldhead, where the presence of contaminated helium gas is suspected a charge and vent adaptor is required. Refer to Section 8 for details of the Oxford Cryosystems coldhead accessory range. For the following procedure reference should first be made to the charge and vent adaptor working instructions to ensure familiarity with the product and its usage. The clean-up procedure is as follows (refer to Figure 6.1):

1. Cool down the coldhead and operate for 1 to 3 hours.

*Note: Contaminants in the helium gas circuit tend to freeze inside the coldhead during operation. The longer the coldhead is operated beyond the one-hour period the greater the volume of contaminations isolated in the coldhead and the more effective the de-contamination process will be.*

| WARNING |
| --- |
| High internal pressures can result during warm-up if a coldhead is disconnected from the gas line when cold. When carrying out the procedure for coldhead de-contamination, immediately vent the coldhead (using the charge and vent adaptor accessory) down to 2 bar (30 p.s.i.g.) after disconnecting the gas lines. |

2. Shut down the coldhead by switching the compressor off.

3. Immediately after the coldhead is shut down, disconnect the helium supply and return lines from the coldhead.

4. Immediately attach the charge and vent adaptor accessory to the high pressure (red) coldhead connection ensuring that all three valves on the adaptor are shut.

5. Immediately following Step 4, reduce the pressure in the coldhead to 2 bar (30 p.s.i.g.) using the charge and vent adaptor valve V1 to vent the coldhead.

| CAUTION |
| --- |
| Do not reduce the coldhead pressure below 2 bar (30 p.s.i.g). Reduction of pressure below this level could introduce additional contaminants into the coldhead. |

6. Allow 3 hours for the coldhead to warm up to room temperature. If required the warm-up time can be shortened by back-filling the vacuum enclosure to atmospheric pressure with dry argon or nitrogen.

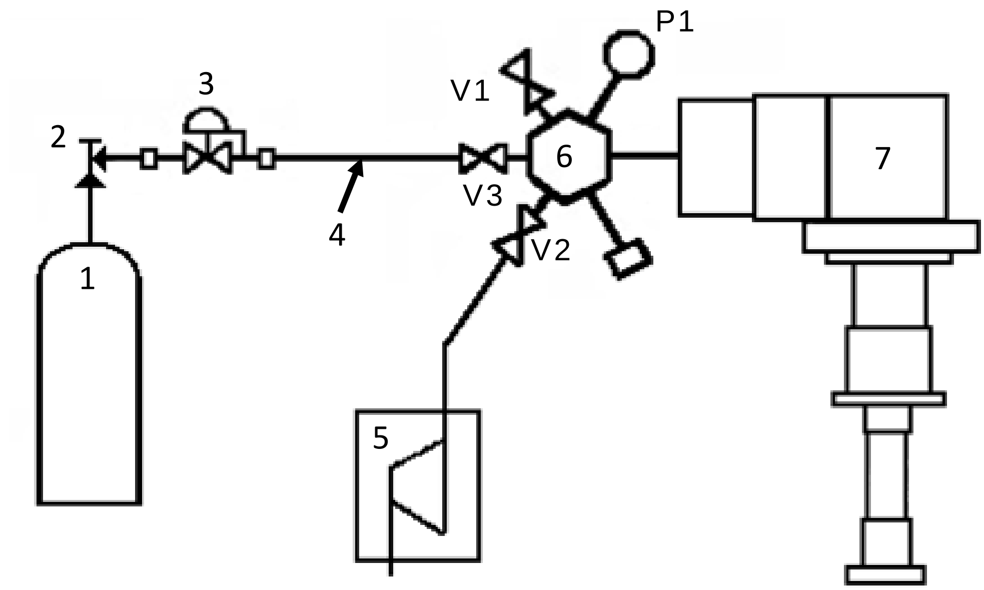



**Figure 6.1 - Purging the coldhead**

1. Helium cylinder
2. Isolation valve
3. Pressure regular
4. Helium line
5. Vacuum pump
6. Charge and vent adaptor
7. Coldhead

7. Ensure that a helium cylinder (1) and suitable regulator (3) to provide up to 17 bar (246 p.s.i.g.) pressure are available. It is recommended that the maximum supply pressure of the regulator used does not exceed 40 bar (580 p.s.i.g.).

CAUTION

Do not use helium that is less than 99.995% pure (dew point -27°C/ -16.6°F).

8. Connect a helium line (4), with an end termination suitable for connecting the 7/16 UNF (20 T.P.I.) male flare fitting on the charge and vent adaptor valve V3, to the regulator. Do not connect this line to the adaptor at present. Set the pressure regulator to zero supply pressure and open the cylinder isolation valve (2).

9. To purge the charge line of contaminants, set the regulator to 2 to 3 bar delivery pressure and (with helium is flowing from the end of the charging line) connect the line to the flare fitting on the charge and vent adaptor (valve V3).

10. With the charging line valve V3 shut, open the regulator valve to give a pressure of 17 bar (246 p.s.i.g.) in the charging line.

11. Ensure valves V2 and V1 are both shut.

12. Back-fill the coldhead with helium through the charge and vent adaptor valve V3 to 16.5±1.0 bar (242 ± 145 p.s.i.g.). Close valve V3.

13. Depressurise the coldhead to 2 bar (30 p.s.i.g.) using valve V1. If a vacuum pump is available, evacuate the coldhead via V2 down to less than 1 mbar.

14. Flush the coldhead by repeating Steps 11 to 13 four more times.

15. Back-fill the coldhead again at the completion of the fifth flush to a pressure of 16.5±1.0 bar (242±14.5 p.s.i.g.) and run the coldhead drive motor for about 20 seconds by switching the compressor ON/OFF switch to ON.

16. If a vacuum pump is not available to evacuate the coldhead then depressurise the coldhead and repeat Steps 11 to 15 four more times. The flushing procedure (Steps 12, 13) will then have been carried out 25 times with 5 intermediate coldhead drive motor runs (Step 15) at the completion of each fifth flush.

17. Check that the coldhead is pressurised to a pressure of 16.5±1.0 bar (242 ± 14.5 p.s.i.g.).

18. Shut off the regulator, disconnect the gas supply line from the charge and vent adaptor, remove the charge and vent adaptor and reconnect the helium supply and return lines to the coldhead. Ensure that the colour coding of each line and connection is correctly matched.

19. Return the installation into service.

# 7 Coldhead servicing

## 7.1 Coldhead service kit contents

These instructions cover the routine service of 12 W coldheads using the appropriate coldhead service kit available from Oxford Cryosystems.

**12 Watt coldhead service kit (22GM-910B000A) used for:**

- Coolstar 400/800 pumps
- 0/12 coldhead
- 2/9 coldhead

| Label | Item Code | Item Description | Quantity |
|---|---|---|---|
| **SK-A1** | 44GM-910C100A | Coldhead 12W Gas Adaptor | 1 |
| **SK-A2** | 99BS-OR4095X262NI60 | 40.95 ID x 2.62 NI60 'O' Ring | 1 |
| **SK-A3** | 99BS-OR67X3NI70 | 67 ID x 3 NI70 'O' Ring | 1 |
| **SK-A4** | 99BS-OR442X178VI60 | 44.2 ID x 1.78 VI60 'O' Ring | 1 |
| **SK-A5** | 99BB-911H250A | Coldhead 12W Valve | 1 |
| **SK-A6** | 99BS-OR1716X178NI60 | 17.16 ID x 1.78 NI60 'O' Ring | 1 |
| **SK-A7** | 99BS-OR602X262NI60 | 6.02 ID x 2.62 NI60 'O' Ring | 1 |
| **SK-A8** | 99BS-OR29X178VI70 | 2.9 ID x 1.78 VI70 'O' Ring | 1 |
| **SK-A9** | 99BS-QR919X262VI70 | 9.19 ID x 2.62 VI70 Quad-Ring | 1 |
| **SK-A10** | 99BS-OR1077X262VI60 | 10.77 ID x 2.62 VI60 'O' Ring | 1 |
| **SK-A11** | 99GR-M3x8SLTCS | M3 x 8 Slotted Countersunk | 2 |
| **SK-A12** | 99BS-OR925X178VI60 | 9.25 ID x 1.78 VI60 'O' Ring | 1 |
| **SK-A13** | 99BB-911H310A | 12W Piston Seal Crossflon | 1 |
| **SK-A14** | 99BS-OR925X178VI60 | 9.25 ID x 1.78 VI60 'O' Ring | 2 |
| **SK-A15** | 99OC-22008-4 | Aeroquip 3/8 Gasket | 5 |
| **SK-A16** | 99BS-OR14X178NI60 | 14.0 ID x 1.78 NI60 'O' Ring | 1 |
| **SK-A17** | 99BS-OR203X262SI50 | 20.3 ID 2.62 SI50 'O' Ring | 1 |
| **SK-A18** | 99BB-911H305A | 12W Displacer Seal Split | 1 |
| **SK-A19** | 99BB-911H300A | 12W Displacer Seal Thin | 1 |
| **SK-A20** | 99BS-OR76X262VI60 | 7.6 ID x 2.62 VI60 'O' Ring | 1 |
| **SK-A21** | 99SP-911R270A | Retaining Ring 2/9 Coldhead | 1 |
| **SK-A22** | 99GM-910H100A | 2/9 Cold Seal Fitting Tool | 1 |
| **SK-A23** | 99BB-911H280A | 12W Cold Seal Female Split | 1 |
| **SK-A24** | 99BB-911H290A | 12W Cold Seal Male Split | 1 |
| **SK-A25** | 99GM-1T0225 | Wavy Washer 23 x 29.5 x 0.2 | 4 |

**Table 7.1 - 12 W coldhead service kit contents**

PLEASE ENSURE THAT YOU HAVE FOLLOWED THE PROCEDURES GIVEN IN THE COLDHEAD MANUAL FOR DECONTAMINATION OF THE COLDHEAD BEFORE ATTEMPTING TO SERVICE THE COLDHEAD. IF YOU HAVE ANY QUESTIONS ABOUT THIS, CONTACT YOUR LOCAL OXFORD CRYOSYSTEMS AGENT OR OFFICE.

## 7.2 General

It should not be necessary to service a coldhead before 15,000 operating hours unless it has been run extensively at motor speeds greater than 72 rpm. The need for service is generally indicated by a degradation of ultimate temperatures and can be postponed until this loss becomes unacceptable without any risk of damage to the coldhead.

### 7.2.1 Preparation

The coldhead may be serviced without removal from the system. If the complete coldhead is removed, care must be taken to avoid damaging the thin wall tube sections. To prevent high pressures developing within the coldhead it should be switched off for at least 1 hour before disconnecting the gas lines.

> WARNING
>
> Do NOT disconnect the coldhead supply and return gas lines during or immediately after low temperature operation unless for cold purging during decontamination procedures.

The coldhead must be fully warmed to room temperature before servicing to avoid exposure and wetting of the coldhead internal surfaces with atmospheric moisture. It is important to avoid any contamination of the coldhead internal components by dirt, fluid oils or greases. This is especially applicable to the displacers which have been dehydrated during manufacture. It is advisable to prepare a clean working surface and use clean lint free gloves when handling the displacers.

### 7.2.2 Depressurising

With the coldhead fully warmed to ambient, disconnect the coldhead drive motor lead and gas lines. If disconnection is difficult due to worn coupling threads the Aeroquip couplings should be replaced.

> WARNING
>
> Never dismantle the coldhead whilst it is still cold. Condensation wetting of the internal components may cause malfunction or degraded performance.

Depressurise the coldhead from the high pressure port (colour coded RED) using the coldhead Gas Adaptor (**SK-A1**) supplied in the service kit.

> WARNING
>
> Never attempt to dismantle the coldhead without first venting its 16 bar helium charge to atmosphere. Ensure that when depressurising a coldhead the vented gas is safely directed away from personnel.

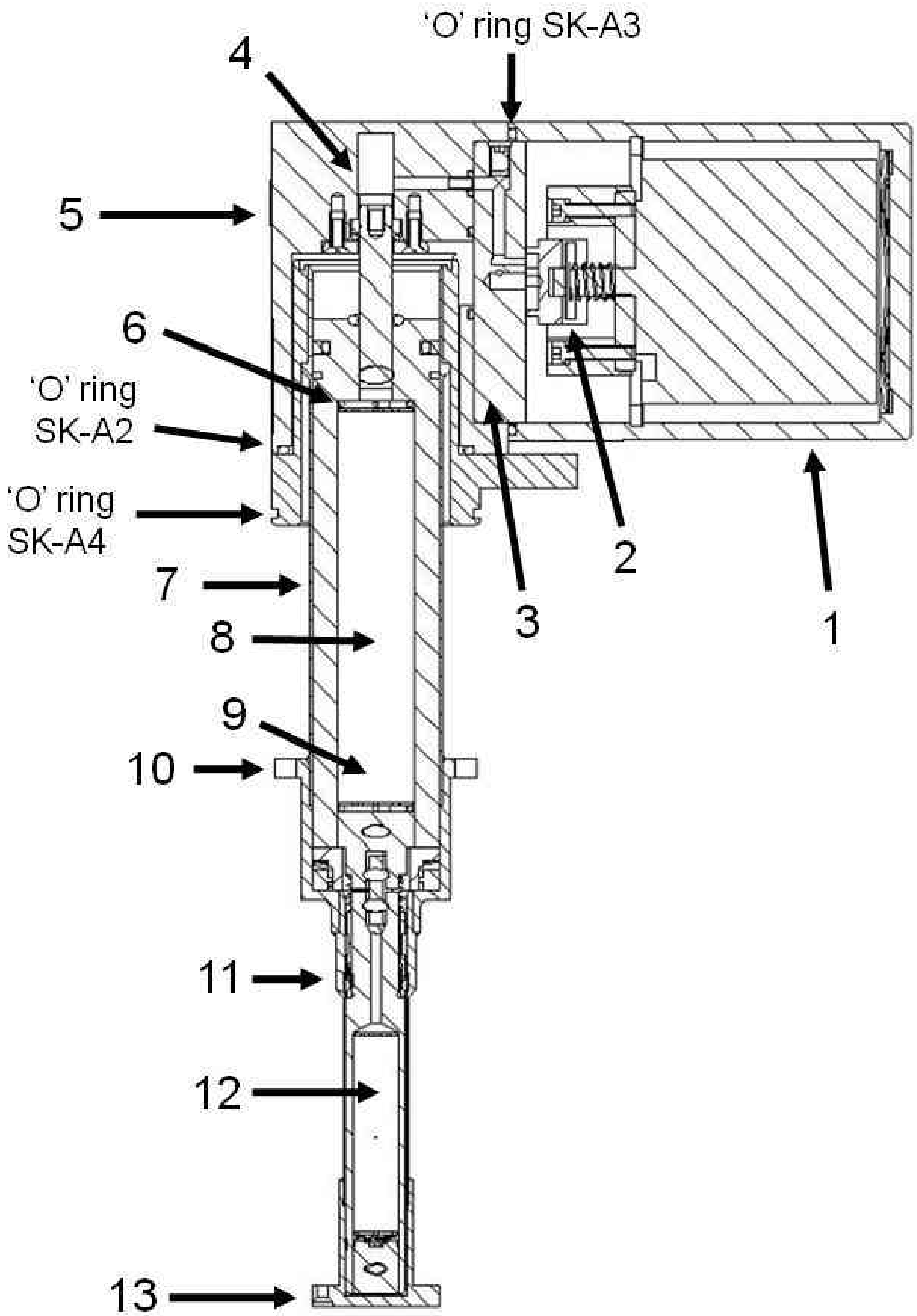



**Figure 7.1 - 2/9 coldhead assembly**

1. Motor housing
2. Valve
3. Valve plate
4. Piston and piston seal
5. Drive housing
6. Warm buffer and warm seal
7. Tube assembly
8. First stage displacer
9. Cold buffer
10. First stage heat station
11. Cold seal
12. Second stage displacer
13. Second stage heat station

## 7.3 Coldhead servicing

### 7.3.1 Removal of drive housing and motor housing assemblies

With reference to Figure 7.1, proceed as follows:

1. Remove the four M6 x 12 socket cap head screws clamping the drive and motor housing assemblies to the coldhead tube assembly flange and lift away.
2. Remove the four M6 x 30 socket cap head screws securing the motor housing to the drive housing and separate the two components.
3. Remove and replace 3 'O' rings (**SK-A2, SK-A3** and **SK-A4**) if necessary.

### 7.3.2 Valve and valve plate inspection

Remove the valve from the motor housing (see Figure 7.2) and inspect for evidence of wear. If the depth of the face slot is less than 1.5 mm the valve should be replaced with a new one from the service kit (**SK-A5**). Using clean tissue wipe clean the valve and motor shaft. Replace the valve on the motor shaft, and then check for free motion of the valve and the energising spring.

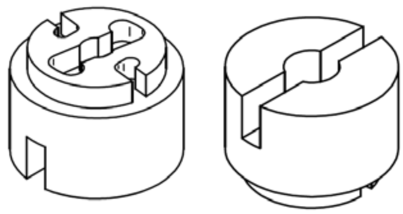


**Figure 7.2 - Valve**

The valve plate (situated in the drive housing) should be lifted away from the drive housing after the removal of the two retaining socket cap head screws. The three sealing 'O' rings (SK-A6, SK-A7 and SK-A8), located in the valve plate recess (see ), should be replaced and the recess cleaned using lint-free tissue. Inspect the wearing surface of the valve plate. If the hard anodised surface is worn to expose bare metal then the valve plate should be replaced. If required, please contact Oxford Cryosystems.

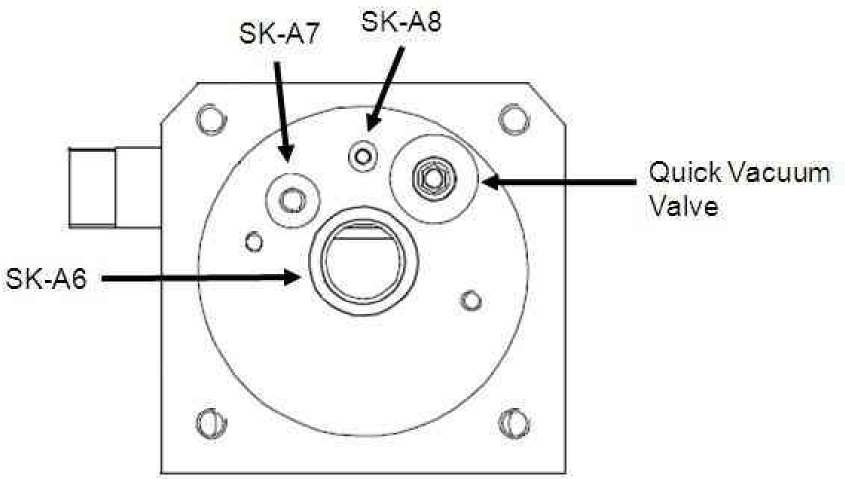



**Figure 7.3 - Valve Plate Recess**

### 7.3.3 Quick vacuum valve

Turn over the drive housing and remove the quick vacuum valve (see **Figure 7.4**) by pushing up from the underside. Replace the quad-ring (SK-A9) and the 'O' ring (SK-A10) shown in Figure 7.4. The quad-ring should be lightly greased prior to fitting and the valve re-assembled. Now refit the valve plate.

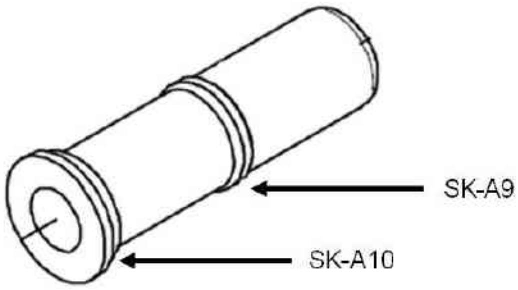
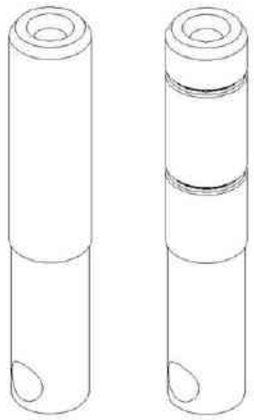



**Figure 7.4 - Quick vacuum valve**

### 7.3.4 Piston seal replacement (Crossflon piston type only)

> **Note**
>
> New models of the coldheads have a metal piston and are not replaced. Please contact Oxford Cryosystems if you require more information.

The piston can be identified by having grooves (metal piston) or no grooves (Crossflon type), see below. The service kit will only have the Crossflon type piston seal. If you are unsure which piston your coldhead has, please contact Oxford Cryosystems.




With reference to Figure 7.5, proceed as follows:

Remove the two slotted countersunk screws securing the piston seal keeper plate to the drive housing and remove the plate. If necessary replace screws with new screws from the service kit (**SK-A11**).

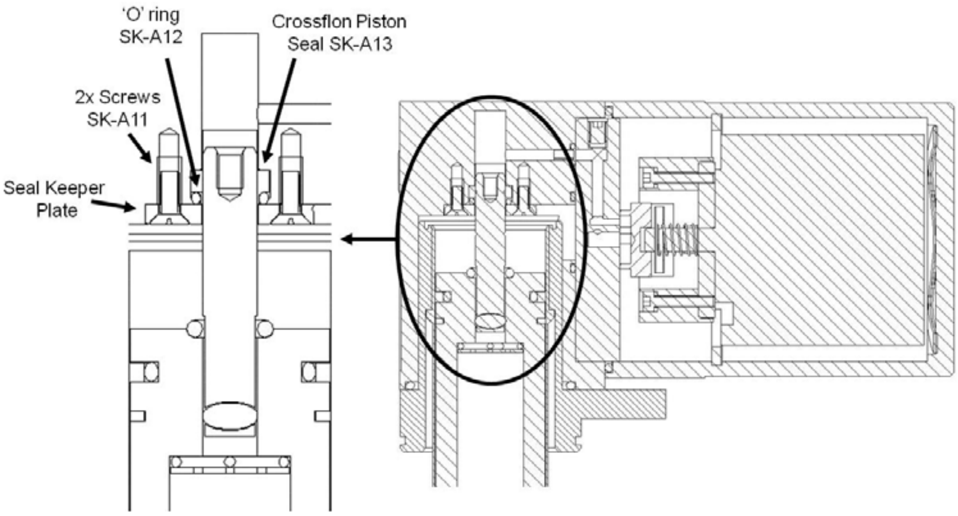



**Figure 7.5 - Piston seal assembly**

The piston seal can now be removed by inserting the displacer piston into the seal and rocking whilst pulling gently on the displacer. Wipe any debris from the piston seal recess.

Fit a new piston seal 'O' ring (**SK-A12**) and new Crossflon piston seal (**SK-A13**) from the service kit.

Lightly lubricate the mouth of the piston seal location bore in the drive housing with Apiezon or Fomblin vacuum grease to aid entry of the new seal assembly.

Fit the replacement piston seal to the drive housing and push down firmly into position.

Refit the piston seal keeper plate. The retaining screws should be tightened using only moderate torque (100 Ncm maximum).

Check the fit of the displacer piston in the installed piston seal. The friction force necessary to withdraw the piston from the seal can be measured using a spring balance and should be between 0.5 kg to 0.7 kg force (this is not applicable for new coldhead metal piston seal types).

Excessive friction will not cause damage but may require a longer 'running in' period before the coldhead develops full power.

If the displacer piston has worn to the extent that it has too low a friction force in the new seal then the piston should be replaced.

#### 7.3.5 Aeroquip and four-pin electrical connector

Unscrew the aeroquip from the motor housing and the drive housing (see Figure 7.6) bulkhead connectors. Replace two 'O' rings (**2x SK-A14**) and re-assemble the aeroquip. Replace the aeroquip 3/8 Gasket (**2x SK-A15**).

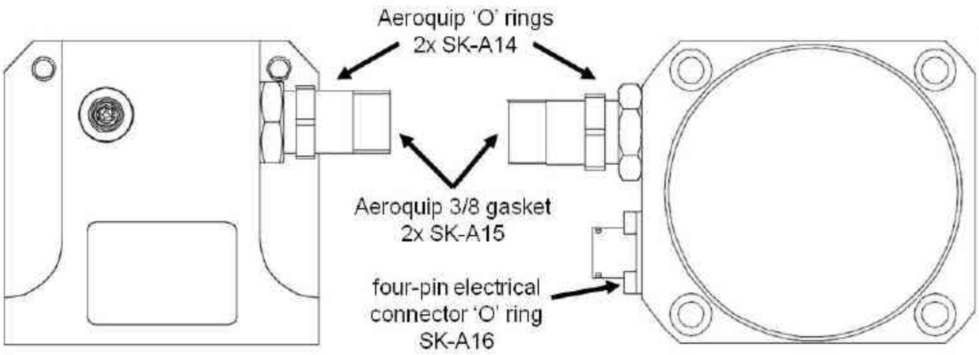



**Figure 7.6 -** ***Drive Housing and Aeroquip (left) and Motor Housing with Aeroquip and four-pin electrical connector (right)***

The 'O' ring (**SK-A16**) under the four-pin electrical connecter may be replaced if required.

At this point the motor housing and drive housing may now be re-assembled. Lightly grease (Apiezon or Fomblin vacuum grease) the interface 'O' ring (**SK-A3**), place it over the valve plate and re-assemble the motor and drive housing using the four M6 x 30 screws previously removed (torque to 8 Nm maximum). Take care to ensure the valve remains correctly located on the motor shaft.

#### 7.3.6 Removal of displacer assembly and component cleaning

Note

Always use gloves when handling the displacer.

Using an M4, screw into the displacer piston seen protruding from the open end of the tube assembly, and withdraw the displacer assembly.

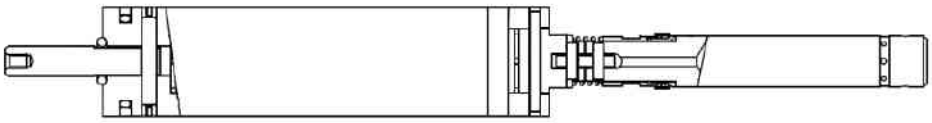


**Figure 7.7 - 2/9 coldhead displacer assembly**

It should be sufficient to wipe wear debris from the coldhead displacer components using clean dry tissue or lint free cloth. Cleaning solvents should only be applied to metallic parts. If cleaning solvents accidentally contact the non-metallic phenolic displacer components then the complete displacer should be vacuum dried at 80°C maximum for 24 hours before use.

CAUTION

Wetting of the displacer surfaces can result in a decrease of coldhead performance.

The interior of the coldhead tube should be blown clear of wear debris using a jet of compressed gas from a plastic tube (to avoid damage to the tube bore).Wipe any wear debris from the displacer assembly.

### 7.3.7 Warm seal replacement

Remove the displacer warm seal by opening at the split and sliding off the displacer (see Figure 7.8).

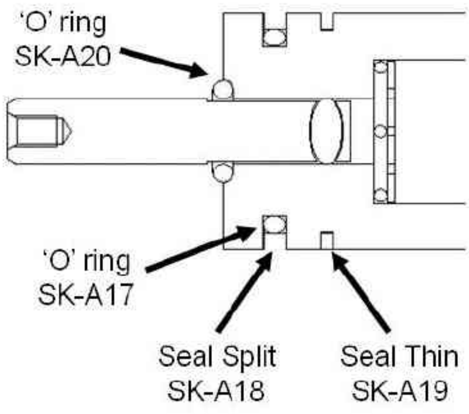



**Figure 7.8 - Warm seal replacement on first stage assembly**

Inspect the 'O' ring exposed by removal of the warm seals for evidence of surface abrasion. Replacement is rarely necessary but, should there be any doubt about the condition, it should be removed as follows.

> Note
>
> Take care not to damage the sealing faces of the warm seal groove or coldhead performance will be affected.

Feed a piece of fine wire tangentially down one flank of the groove to pass under the 'O' ring and up the other flank. The 'O' ring can now be pulled from the displacer and the replacement 'O' ring fitted (**SK-A17**).

Fit the replacement warm seals (**SK-A18 and SK-A19**) and replace the warm buffer 'O' ring (**SK-A20**).

The friction force should now be measured and should be between 1.2 Kg to 1.8 Kg.

### 7.3.8 Cold seal replacement on model 2/9 only

With reference to Figure 7.9, proceed as follows:

**Diagram A**

First ensure that the cold seals (1 and 2) have been removed. Then remove the retaining ring (3) by gently opening it out and sliding it off the end of the second stage displacer.

> CAUTION
>
> The cold seals will be distorted rendering it ineffective if it is opened and pulled sideways off the displacer.

**Diagram B**

Inspect the retaining ring for distortion and replace with one from the service kit if necessary (**SK-A21**). Fit the retaining ring to the seal fitting tool (**SK-A22**) provided with the Coldhead service kit. Fit the new female cold seal (**SK-A23**) into the displacer seal groove. Holding the seal joint closed, slide the fitting tool over the end of the displacer and up to the seal such that the retaining ring opening is 90 degrees displaced from the female seal joint.

**Diagram C**

Holding the retaining ring with the fingers of one hand withdraw the fitting tool with the other such that the retaining ring slides off the tool onto the seal. The seal should now be held closed by the retaining ring.

**Diagram D**

Pull back the energising ring (5) and fit the male cold seal (**SK-A24**) with the chamfered edge facing and engaging under the female cold seal and the split aligning with the retaining ring split (i.e. 90 degrees displaced from the female cold seal split). Ensure that the split in the male cold seal is closed then gently release the energising ring. It is not necessary (and makes fitting more difficult) to ensure that the male cold seal is also covered by the retaining ring.

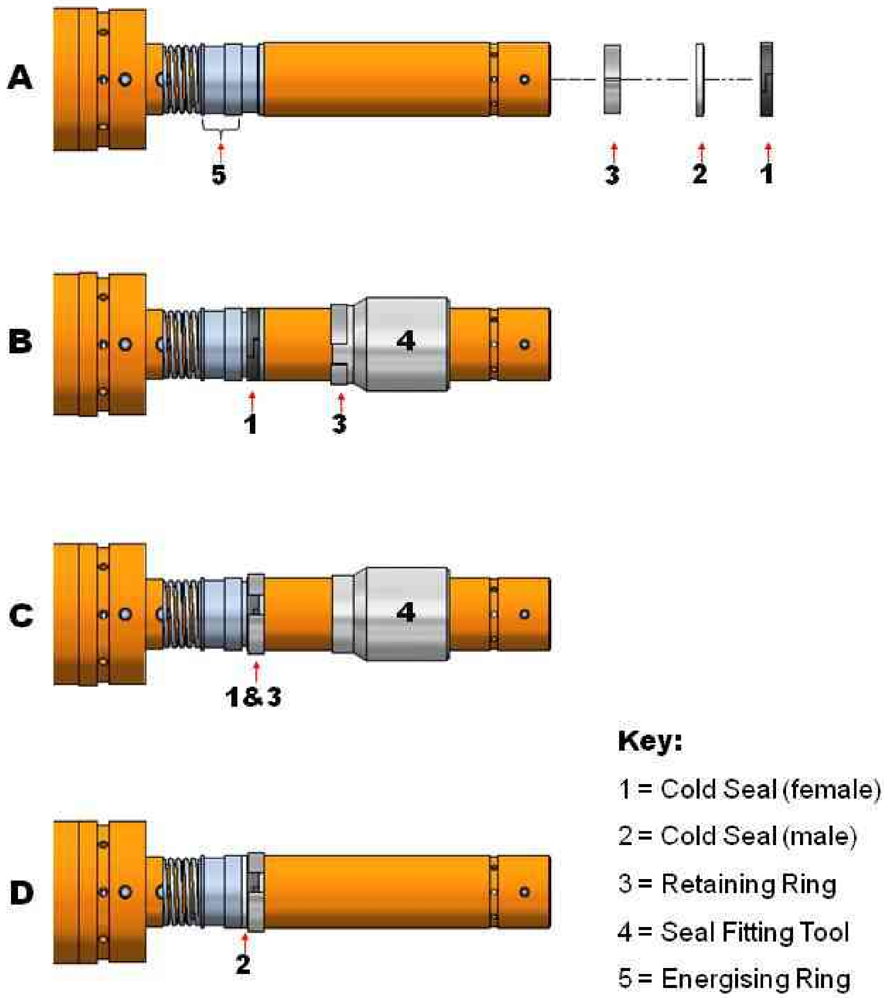



**Figure 7.9 - Cold seal replacement**

#### 7.3.9 Cold buffer inspection on model 2/9 only

Inspect the cold buffer wavy washers for evidence of fracture or damage.

Place the assembly on a working surface and with a screwdriver blade inserted at the split in the female half, lever it open and off the male. Replace the wavy washers (**SK-A25**) and re-assemble. Check that the wavy washers are correctly located between the buffer halves.

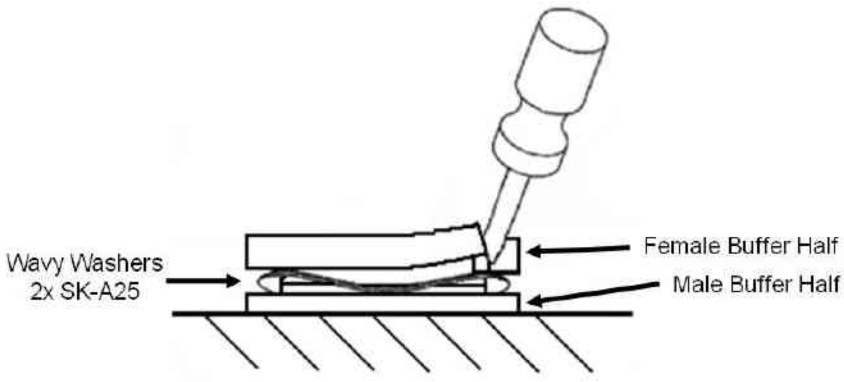



**Figure 7.10 - Cold buffer dismantling**

## 7.4 Re-assembly

Insert the displacer into the displacer tube. On the 2/9 model, it may be necessary to rotate the displacer to allow the smaller diameter second stage to engage into its tube. The displacer assembly should slide freely into the tube using minimal force until the warm seals are about to enter the tube. Resistance felt before this may indicate that the cold seal has fouled the buffer and the displacer must be removed to check the cold seal assembly.

Push the displacer fully home within the displacer tube.

Locate the drive housing/displacer tube interface 'O' ring (**SK-A2**) lightly greased over the end of the displacer tube assembly. Refit the drive housing using the four cap M6 x 12 head screws (torque to 8 Nm maximum).

## 7.5 Helium purging

It is essential to performance that the coldhead is effectively purged to remove contamination (principally air) which would otherwise solidify within the coldhead during cryogenic operation.

Use a purge adaptor (not supplied in service kit) and fit this to the high pressure coldhead connection (red) ensuring that all three valves on the adaptor are shut.

Continue the purge process as described in the coldhead operation manual using a vacuum pump to evacuate the head.

## 7.6 Leak checking

Providing the surfaces sealing against helium leakage to atmosphere are free from damage and debris and all sealing ‘O’ rings are greased with Apiezon or Fomblin vacuum grease on assembly, there should be no noticeable loss of pressure between service intervals.

Coarse leak checking may be carried out using proprietary solutions after the coldhead has been re-pressurised. These solutions should be applied principally to those joints disturbed during servicing.

CAUTION

Soap/water solutions or diluted detergents must not be used for leak checking. These cause corrosion and leave thick residues.

Highly sensitive leak detectors may reveal an apparent leak in the area of the sealing 'O' rings. This can be due to permeation of helium through the bulk of the seal material which is unavoidable and acceptably small.

# 8 Accessory range

The following accessories are available from Oxford Cryosystems for use with the Coolstar coldheads.

| Product description | Order code |
|---|---|
| 0/12 and 2/9 standard helium gas line (3 metre pair) | 22GM- 975B000A |
| Extension helium gas line (3 metre pair) | 99SS-B517-16-000 |
| Helium gas line 'T' piece for two coldheads (pair) | 22GM- 970B100A |
| Helium gas line 'X' piece for three coldheads (pair) | 22GM-970B150A |
| Charge and vent adaptor | 22GM- 970B050A |

**Table 8.1 - Accessories**

# 9 Equipment return procedure

## 9.1 Introduction

Before you return your equipment you must warn Oxford Cryosystems if the substances you used (and produced) in the equipment can be dangerous. You must do this to comply with health and safety at work laws.

You must contact Oxford Cryosystems before you dispatch the equipment. If you return the equipment without warning, there may be a delay in processing your equipment.

### 9.1.1 Oxford Cryosystems Ltd contact details:

Email: support@oxfordcryosystems.co.uk

Phone: +44 (0)1993 883488

Fax: +44 (0)1993 883988

## 9.2 Guidelines

Take note of the following guidelines:

Your equipment is 'uncontaminated' if it has not been used or if it has only been used with substances that are not dangerous. Your equipment is 'contaminated' if it has been used with any dangerous substances.

If your equipment has been used with radioactive substances, you must decontaminate it before you return it to us. You must send independent proof of decontamination (for example a certificate of analysis) to us. If you require more information please phone or email for advice.

We recommend that contaminated equipment be transported in vehicles where the driver does not share the same air space as the equipment.

## 9.3 Returns procedure

Use the following procedure:

1. Contact Oxford Cryosystems Ltd and obtain an 'RMA' number for your equipment and a Repair Form. You must return the Repair Form to Oxford Cryosystems by email or fax BEFORE you send us any items.

2. Remove all traces of dangerous gases: pass an inert gas through the equipment and any accessories that will be returned to Oxford Cryosystems Ltd. Drain all fluids and lubricants from the equipment and its accessories.

3. Disconnect all accessories from the equipment. Safely dispose of the filter elements from any oil mist filters.

4. Seal up all of the equipment's inlets and outlets (including those where accessories were attached). You may seal the inlets and outlets with blanking flanges or heavy gauge PVC tape.

5. Seal contaminated equipment in a thick polythene bag. If you do not have a polythene bag large enough to contain the equipment, you can use a thick polythene sheet.

6. If the equipment is large, strap the equipment and its accessories to a wooden pallet. Preferably, the pallet should be no larger than 510mm x 915mm (20"x 35"); contact Oxford Cryosystems if you cannot meet this requirement.

7. If the equipment is too small to be strapped to a pallet, pack it in a suitable strong box.

8. If the equipment is contaminated, label the pallet (or box) in accordance with laws covering the transport of dangerous substances.

WRITE YOUR 'RMA' NUMBER CLEARLY ON THE OUTSIDE OF THE ENVELOPE AND ON THE OUTSIDE OF THE EQUIPMENT PACKAGE.